

PROCEEDINGS
OF THE
ROYAL SOCIETY OF EDINBURGH.

VOL. IV.

1861-62.

No. 57.

Monday, 6th January 1862.

The Hon. LORD NEAVES, V.P., in the Chair.

An address of condolence to Her Majesty, on account of the death of his Royal Highness the Prince Consort, was adopted by the Society ; and the Secretary was directed to transmit it, after receiving the signature of the President, to Sir George Grey, Principal Secretary of State for the Home Department.

The following Communications were read :—

1. On the Climate of Palestine in Modern compared to Ancient Times. By Principal Forbes.

In this paper the writer proposes to revise and extend the argument used thirty years ago by the late Professor Schouw of Copenhagen, as to the climate of Palestine, founded on the coincident cultivation of the Date Palm, and the Vine: the one plant nearly ceasing to bring its fruit to maturity when the other begins to be productive. Tropical heat is as necessary to the maturity of the date as it is injurious to the manufacture of wine.

In Schouw's ingenious paper (*Edinburgh Journal of Science* for 1828), by a strange oversight, the great range of temperature of Judæa and of Palestine generally, due to the mountainous nature of the country, and to the anomalous depression of the valley of the Jordan,* was left out of account ; and hence the force of the argument for the uniformity of ancient and modern climates

* The latter fact was in 1828 imperfectly ascertained.

was materially weakened. The present writer takes these circumstances into account. He farther uses the information with which modern travellers have furnished us as to the physical and botanical geography of Palestine, including the data obtained from thermometric registers at Jerusalem and elsewhere; and he arrives at the following conclusions:—

1. That judging from the known thermometric conditions of the growth and maturity of the date palm, compared with the evidences in Scripture of its distribution and culture in Ancient Palestine, the mean temperature of the site of Jerusalem, when reduced to the level of the sea, can have then differed but little from 70° Fahrenheit, which is its present value according to the best authorities. We conclude, with still more certainty, that the temperature could not, anciently, have been *colder* than this.

2. That comparing the conditions which limit the cultivation of the vine, we find that as it certainly was not anciently less, but *more* general and advantageous than at present, the climate of Palestine could not have been materially *hotter* than now belongs to its geographical position, taking also into account the modifying influence of height above the sea.

3. That this argument is enhanced by the evidence from hieroglyphics, and also from Scripture, that the cultivation of the grape was anciently more extensive in Egypt than it now is. That while this might seem to point to the conclusion that these countries are *hotter* now than formerly, the difference is sufficiently accounted for by political circumstances, and the conclusion is itself negatived by the evidence to the contrary derived from the date palm.

4. Hence the climate of Palestine, being neither sensibly hotter nor colder than it anciently was, is of course unchanged; and the direct evidence of modern travellers on the distribution of the vine and palm in that country leads to the same result.

2. Biographical Notice of Andrew Dalzel, Professor of Greek in the University of Edinburgh. By Professor Innes.

Professor Dalzel was born in 1742, at Gateside of Newliston. His father died while he was still an infant, and he was educated partly by his uncle, the minister of Stony Kirk, in Galloway, and after *his* death, by his mother, at Newliston. He attended the

parish school of Kirkliston, and from thence went to college at Edinburgh. His companion at both was Robert Liston, afterwards Sir Robert, the ambassador. The boys began life together. Liston was just two days younger than his friend, and the intimacy of school and college lasted through life. It is chiefly from the correspondence kept up between them from 1766 till 1805 that the present Memoir has been compiled.

On leaving college, Dalzel was for some time tutor in the family of Lauderdale, and the friendship so commenced also remained firm and unbroken through life.

In 1772-73, partly by an arrangement with his predecessor, partly through the influence of the Lauderdale with the Town Council, Dalzel became Professor of Greek in the University. The study of that language had fallen much into decay in Scotland, and Dalzel set himself zealously to the task of restoring and promoting it. He devoted himself to the duties of his class, and was soon rewarded by its increase in numbers and improvement in study. Among other means for his object, he set about preparing some class-books for Greek students which were then unknown. His first publication was a little supplement to Moor's Grammar, under the title of *Fragmenta Grammatices Græcæ in usum tironum in literis Græcis in Academia Edinensi*. The prose volume of his well-known *Collectanea Majora* was published in 1785, and got almost at once into favour with the best teachers here and in England.

In the immediate duties of his professorship Dalzel was indefatigable. Dr Monro said of him, that "he had more to brag of than any man in the college, for that Greek was going fast downhill till he revived it." His second volume, the poetical portion of the *Collectanea Majora*, cost him great labour, and obtained the assistance of many friends among the best scholars of England. Though long promised and urgently called for by the schoolmasters and "the trade," it was not published till 1797. It was then received with as much favour as its predecessor; and the two volumes rapidly came to supersede all other class-books for Greek students. Both volumes passed through many editions, and perhaps wanted nothing for permanent success and popularity, but that the valuable information conveyed in the notes should have been given in English instead of Latin, which the practice of the time seemed to require.

Dalzel married, in 1786, Anne, daughter of Dr John Drysdale, the well known clerk of the General Assembly, and one of the leaders of the Church. His marriage connected him with the Adams, Principal Robertson, the Kennedys of Dunure, the Broughams, Elliots of Minto, and the rest of that remarkable group of Edinburgh families. His professorial position brought him into intimate acquaintance with the philosophers and scholars who then made our University famous. His labours in publishing books for his class, connected him with many distinguished scholars; and a good deal of his correspondence is preserved and used for this Memoir. It embraces letters from Heyne, Böttiger, Porson, Parr, Bishop Burgess, Dr Raine of the Charterhouse, Tate, the excellent master of Richmond school, Thomas Young, the scientific philosopher and universal scholar.

The Memoir has frequent notices of the commencement and progress of the University buildings, and other academic matters; including the first *Symposium Academicum*, the death and character of Principal Robertson, the commencement of the Society of Antiquaries, and in connection with it, the foundation of the Royal Society, of which Dalzel was an original and active member. It notices also some passing events; such as visits of remarkable persons to Edinburgh, the impression made by Burke, by Burns, by Mrs Siddons, &c.

But the chief object of the Memoir, as of Dalzel's whole life, is the restoration of Greek and classical education in Scotland. The writer gives his reasons for preferring a classical discipline to either a purely metaphysical or a merely physical course of education, formerly and now preferred among us.

Dalzel's character was singularly amiable. Living in factious and contentious times, in a society not always peaceful, he courageously avoided all quarrels, and gave his whole energy to his duty. In society and his family he was equally fortunate and beloved; and his life is an example of happiness uninterrupted, arising from successful devotion of talents to a worthy object. Dalzel died on the 8th December 1806.

The following Gentlemen were admitted Fellows of the Society:—

HENRY CHEYNE, Esq., W.S.
Rev. W. G. BLAICKIE, M.A.

- The following Donations to the Library were announced :—
- Annales Hydrographiques. Tome VI.—VIII. 8vo.—*From the Dépôt de la Marine.*
- Instructions Nautiques sur les Mers de l'Inde. Par J. Horsburgh. Tome III., 2nd partie. 1860. 4to.—*From the same.*
- Mer du Nord, Troisième partie. Côtes Est d'Angleterre. 1860. —*From the same.*
- Description Hydrographique des Côtes Septentrionales de la Russie. Par M. Reineke. Première partie. Mer Blanche. 8vo. 1860. —*From the same.*
- Catalogue par Ordre Géographique des Cartes, Plans, Vues de Côtes, Mémoires, Instructions Nautiques, &c., qui composent l'Hydrographie Française. 8vo. 1860.—*From the same.*
- Catalogue Chronologique des Cartes, Plans, Vues de Côtes, &c.—8vo. 1860.—*From the same.*
- Renseignements Hydrographiques sur la Mer de Chine, la Corée, la Mer et les Îles du Japon. 8vo. 1860.—*From the same.*
- Instructions Nautiques sur les Traverses d'Aller et de Retour de la Manche à Java. 4to. 1861.—*From the same.*
- Détroit de Banka. Nouvelle Passe pour donner dans le Détroit en venant du Sud. 8vo. 1860.—*From the same.*
- Influence des Courants sur la Navigation à la Côte Occidentale d'Afrique. Par M. Vallon. 8vo. 1860.—*From the same.*
- Description des Basses et des Dangers, qui sont près de la Côte S.E. de l'Île de Ceylan. 8vo. 1861.—*From the same.*
- Notice sur la Carte des Environs de Cherbourg. Par M. Keller. 8vo. 1861.—*From the same.*
- Note sur l'Évaluation des Distances en Mer. Par M. de la Roche-Poncie. 8vo. 1860.—*From the same.*
- Annuaire des Marées des Côtes de France, pour l'An 1861. Par MM. Chazallon et Gausin. 12mo.—*From the same.*
- French Admiralty Charts.—*From the same.*
- Norges Mynter i middelalderen samlede og beskrevne. Af c.I. Schive. Parts 1–3.—*From the Royal University of Christiania.*
- Fortællinger om Keiser Karl Magnus og Hans Jævnings I Norsk bearbejdelse fra det trettende aarhundrede udgivet af C. R. Unger I. 8vo. Christiania. 1860.—*From the same.*
- Forhandlinger i videnskabs-selskabet. Christiania. 1860. 8vo.—*From the same.*

- Det Kongelige Norske Frederiks Universitets Stiftelse, &c., af M. J. Monrad. 8vo. Christiania. 1861.—*From the same.*
- Oversight af Norges Echinodermer. Ved Dr Michael Sars. Christiania. 1861. 8vo.—*From the same.*
- Nyt Magazin for Naturvidenskaberne. Hefte III., IV. 1861.—*From the same.*
- Norske Plantenavne. Af J. Hafen. 8vo. 1860.—*From the same.*
- Notice sur la Saga de Charlemagne. 8vo.—*From the same.*
- Om Cirklers Berqring. Af C. M. Guldberg. 4to. 1861.—*From the same.*
- Om Kometbanernes indbyrdes Beliggenhed. Af H. Mohn. 4to. 1861.—*From the same.*
- Om Siphonodentalium Vitreum en ny slægt og art af dentalidernes Familie. Af Dr Michael Sars. 4to. 1861.—*From the same.*
- Index Scholarum in Universitate regia Fredericana, 1861. 4to.—*From the same.*
- Solennia Academica Universitatis Literariæ Regiæ Fredericianæ. 4to. 1861.—*From the same.*
- Cantate ved Det Norske Universitets Halvhundredaarsfest. 4to. 1861.—*From the same.*
- Thirty-Fourth Annual Report of the Royal Scottish Academy. 8vo.—*From the Academy.*
- Proceedings of the Royal Horticultural Society, No. XXXI. 8vo.—*From the Society.*
- Observations and Experiments on the Carcinus Mœnas. By W. Carmichael M'Intosh, M.D. 8vo. 1861.—*From the Author.*
- Journal of the Statistical Society of London. Vol. XXIV., Part 4. 8vo.—*From the Society.*
- Sitzungsberichte der Königl. Bayer. Akademie der Wissenschaften zu München. 1861. Heft IV. 8vo.—*From the Academy.*
- Mémorie della Reale Accademia della Scienze di Torino. Tomo XIX. 1861. 4to.—*From the Academy.*
- Nova Acta Regiæ Societatis Scientiarum Upsaliensis. Vol. III. 1861. 4to.—*From the Society.*
- Arsskrift utgifven af Konigl. Vetenskaps-Societetem i Upsala arngangen II. 8vo.—*From the same.*
- Mémoires de la Société de Physique et d'Histoire Naturelle de Genève. Tome XVI., Part 1.—*From the Society.*

- Atti dell' Imp.-Reg. Istituto Veneto di Scienze, Lettere ed Arti.
Vol. VI. Parts 7-9. 8vo.—*From the Institute.*
- Arc du Meridien de 25° 20' entre le Danube et la Mer Glaciale.
Tome I., II. 4to. With an Atlas.—*From the Royal Academy of Sciences, St Petersburg.*
- Mémoires de l'Académie Imp. des Sciences de St Petersburg.
Tome IV., No. 1. 4to.—*From the same.*
- Tabulæ Quantitatum Berselianarum. 1840-1846. 8vo.—*From the same.*
- Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften.
Math.-Nat. Classe. B. XLII., No. 29; B. XLIII., Heft 3-5;
B. XLIV., Heft 1, 2.—Phil.-Hist. Classe. B. XXXVI.,
Heft 3; B. XXXVII., Heft 1-4. 8vo. Wien.—*From the Academy.*
- Denkschriften der Kaiserlichen Akademie der Wissenschaften. Phil.-
Hist. Classe. B. XI. 4to.—*From the same.*
- Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt.
B. XI. 8vo.—*From the same.*
- Almanach der Kaiserlichen Akademie der Wissenschaften. Wien.
1861. 8vo.—*From the same.*
- Annales de l'Observatoire Physique Central de Russie. Année 1858.
Nos. 1, 2. 4to.—*From the Observatory of St Petersburg.*
- Compte Rendu Annuel. 1859-60. 4to.—*From the same.*
- Beobachtungen und Elemente des Cometen. II. 1860. Von O.
Struve. 8vo.—*From the Author.*
- Bemerkungen über den dritten Cometen von 1860. Von Dr A.
Winnecke. 8vo.—*From the Author.*
- Über einen vom Gen. Schubert an die Akademie gerichteten Antrag,
betreffend die Russ-Scand. Meridian-Gradmessung. Von O.
Struve. 8vo.—*From the Author.*
- Abstracts of Spirit-Levelling in Scotland. By Col. Sir Henry James.
1861. 4to.—*From the Ordnance Survey.*
- American Journal of Science and Arts. No. 96. 8vo.—*From the Editors.*
- Report of the Topographical and Geographical Exploration of the
Western Districts of the Nelson Province, New Zealand. 8vo.
1861.—*From the Provincial Secretary's Office, Nelson.*
- Proceedings of the Academy of Natural Sciences, Philadelphia. 8vo.
—*From the Academy.*

Quarterly Journal of the Geological Society. No. 68. 8vo.—*From the Society.*

Abstracts of the Geological Society of London. No. 72. 8vo.—*From the Society.*

Monthly Notice of the Royal Astronomical Society. November 1861. 8vo.—*From the Society.*

Monthly Returns of Births, Deaths, and Marriages. November 1861. 8vo.—*From the Registrar-General.*

On the Concrete used in the late Extension of the London Docks. By George Robertson, C.E. 8vo.—*From the Author.*

An Investigation into the Theory and Practice of Hydraulic Mortar. By George Robertson, C.E.—*From the Author.*

Monday, 20th January 1862.

JAMES T. GIBSON-CRAIG, Esq., Treasurer, in the Chair.

The following Communications were read :—

1. Note on the Phosphorescence of Berœe. By Professor Allman.

The author stated, as the results of some experiments which he had made on the phosphorescence of a species of *Berœe* (*Idyia*) which abounded during the last summer in the Firth of Forth, that the light is never emitted as long as the animal is exposed to daylight; and that withdrawal from the daylight for some time is necessary, in order to impart to the Berœe the property of phosphorescence.

A glass jar, containing several living specimens of the Berœe in sea water, was removed from the daylight into a dark room, when not the slightest indication of phosphorescence could be detected, though the animals were subjected to precisely the same kind of irritation as is found to be always followed by the emission of light during the night. But after the Berœes had remained for about twenty minutes in the dark, the phosphorescence had become as vivid as by night; the slightest irritation would call it forth, and the vibration communicated to the jar by a blow on the table where it lay, was

sufficient to cause the emission of a vivid flash of beautiful greenish light.

The author was aware that a source of fallacy might exist in the want of sensitiveness in the experimenter to faint luminous impressions, immediately after exposure of his own eyes to ordinary daylight; and accordingly no conclusion was arrived at as to the absence of luminosity until the eye was rendered sufficiently sensitive by confinement for some time in the dark room.

The absence, then, of luminosity in these animals during the day, is not due alone to the phosphorescence being rendered invisible by the stronger daylight, but to the fact that no light whatever is at that time emitted by the animal.

The author also stated that the embryo, while still included within the egg, is eminently phosphorescent, and that the emission of the light is subject to exactly the same conditions as in the adult. He was of opinion that the ova and free embryos of the *Berœ* and other Ctenophora, are among the chief sources of the phosphorescence of the sea in our latitudes—an opinion which finds support in the immense number of ova produced by these monœcious animals, taken in connection with the countless multitudes of Ctenophora which at certain seasons of the year crowd the seas round our coasts.

2. Contributions to our Knowledge of the Structure and Development of the Beroidæ. By Professor Allman.

In this communication the author gave the results of some careful observations and dissections he had made of a species of *Berœ* (*Idyia*), obtained in abundance during the last summer in the Firth of Forth.

In the anatomy of the adult animal, several points were described which seem to have been hitherto either overlooked or imperfectly examined. In the digestive system, the author noticed the presence of two richly ciliated membranous semi-elliptical flaps, which just before the stomach terminates in the narrow neck which leads into the bifurcating funnel, spring from its walls, and extend, by their free extremities, into the neck and commencement of the funnel. The equivalents of these flaps will doubtless be found in the two lips noticed by Milne Edwards in a similar position in *Berœ Forskalii*; and the author is of opinion that they are also the

homologues of the two membranous appendages described by M. Edwards, in the stomach of *Lesueuria vitrea*. He also described the peculiar rod-like cilia noticed by Agassiz, as extending over the whole of the inner surface of the stomach, but which the author finds, in the specimens examined by him, to be confined to a broad band commencing just within the mouth, the remainder of the stomach walls being covered with ordinary cilia, which are very minute except on the contracted neck, where they become long and powerful. Peculiar enigmatical bodies were described as being present in the walls of the ramified cæca which spring from the meridional canals. They are in the form of minute cushion-like discs, which are prominent upon the external surface of the cæcal tubes. The disc is depressed in the centre, and from this depression a little conical elevation projects into the surrounding tissue of the animal. The cæcal tubes are also partially invested by a peculiar layer which extends over irregular spaces of their walls. This layer has been regarded as an extension of the ovary, but the author views it as an entirely independent structure. It is composed of minute cells, and may possibly be an eliminating organ.

A highly-developed system of capillary tubes was described in detail, as constituting one of the most interesting features in the structure of *Berœe*. These tubes seem to have been noticed by Gegenbaur,* who describes a network formed by the anastomosing offsets of cells, and which, in very young individuals, represents a system of repeatedly anastomosing tubes. They seem to constitute the same structure as that which Agassiz at one time† described as muscular fibres in *Cydidippe*—an opinion, however, which he subsequently retracts, preferring, in his latest works,‡ to regard them as merely the optical expression of the walls of very large cells. The author has no hesitation in maintaining that these are all delicate capillary tubes, but without true anastomosis. They are divisible into four sets, differing from one another in their deeper or more superficial position, and in the general direction of their course. He believes that they may be conveniently divided into the following sets:—

* Studien über Organisation und systematik der Ctenophoren. Wiegmann's Archiv, 1856.

† On the Beroid Medusæ of the Shores of Massachusetts. 1860.

‡ Contributions to the Natural History of the United States of America. Vol. III. 1860.

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| 1. Longitudinal. | | 3. Deep circular. |
| 2. Superficial circular. | | 4. Gastro-parietal. |

In the gastro-parietal set, especially, which extend from the walls of the stomach towards the external surface of the body, he had no difficulty in demonstrating a true tubular structure. Under stimulation they contract longitudinally, and become thickened transversely; and then they are plainly seen to be thick-walled tubes, whose cavity encloses a granular matter. The tubules composing the other three sets seem to be also contractile, though this property is not so apparent in them as in the gastro-parietal set. All the four sets depolarise light, and present a similar appearance under the polariscope.

To the two oval ciliated spaces, situated one at either side of the ocellus, the author gave the name of tentacular discs. The margin of each disc is marked by a double line, on whose interval is borne a series of short hollow tentacular processes, simple in young specimens, but irregularly lobed or ramified in adults, covered over their whole surface with fine actively-vibrating cilia, and containing numerous pigment cells in their walls. The double line marks the boundary of a canal which runs round the disc upon its deep surface, and into which the bases of the tentacles open, the canal ceasing to be continuous at the inner extremity of the major axis of the disc, where there is a short space destitute of tentacles. The author maintains that the cavity of the tentacles, and their common basal canal, communicate, through the bifurcations of the funnel, with the general gastro-vascular system.

Eight chord-like organs have been noticed by observers, and have been described in detail by Agassiz as extending from beneath the ocelliform body to the extremities of the eight meridional bands; but the fact has not been hitherto noticed, that where they lie upon the cushion-like body which supports the sense capsule, they coalesce two and two, so as here to be but four in number. These four chords are clothed with true vibratile cilia. The author also described two additional chords, which originate also beneath the ocellus, one at each side, exactly opposite to the tentacular discs, and thence running outwards without dividing, lose themselves in the discs. These, like the former, are clothed with vibratile cilia. The true origin of the chords he believes to be in a ganglion-like tubercle which lies immediately under the sense capsule, and between it and the cushion-

like body. Contrary to the opinion of Agassiz, the author regards these chords as truly representing a nervous system.

The author described four spherical tubercles, situated two upon each side of the cushion-like body, and between it and the tentacular discs. These are the equivalents of exactly similar tubercles described by Agassiz in *Cydippe*, but not noticed by him in his description of *Idyia*.

Development.

In his account of the development of *Beröe*, the author described the ovum, after its escape from the surrounding water, as consisting of a spherical vitellus, surrounded by an external transparent and structureless shell, which is separated by a wide interval from the vitellus, the whole being at this time generally surrounded by an atmosphere of spermatozoa, which are in the form of very minute caudate corpuscles.

No trace of germinal vesicle or spot could be detected in the vitellus, which has the appearance of being composed of minute cells, and whose peripheral portion is differentiated as a somewhat denser layer. A few hours after the escape of the ovum segmentation begins, and this process goes on until the vitellus is broken up into numerous very distinct and quite free spherules, each of which is plainly a cell filled with a multitude of similar cells. The segmenting process, however, has not been going on uniformly in all the divisions, and these resulting spherules are consequently of unequal size, and represent different stages in the process. Next, successive segmentations go on with great activity in some of the spherules, while others continue unaffected by it, or present it with much less energy, and the former become broken up into a multitude of cells, by which the latter are gradually enveloped; so that the ovum now presents two very distinct portions—a central one composed of large spherical cells, and a peripheral one of much smaller cells.

Simultaneously with the completion of the peripheral layer, a large lacuna is formed among the cells in the centre of the ovum. A depression—the future mouth—next takes place upon the surface of the embryo; and this becomes deeper and deeper, until it reaches the central lacuna, into which it finally opens. At the same time, the ocelliform body, with its capsule, and the rudiments of the tentacular discs, become apparent. The refractile corpuscles of which the ocelli-

form body is composed, may at this time be plainly seen to be developed in the interior of delicate spherical cells. The eight meridional bands have also by this time made their appearance, and may be seen in four pairs extending from within a short distance of the ocellus, along the sides of the embryo to about one-fourth of the whole distance from the ocellus to the mouth.

The next stage observed is the differentiation of a portion of the large-celled tissue which constitutes the principal substance of the embryo, into two somewhat piriform masses, extending one on either side of the alimentary cavity, and which, simultaneously with their formation, become excavated by an extension of the large central lacuna. They thus form two large sacs appended to the central lacuna, and opening into it, and are to become the deep longitudinal gastro-vascular canals.

Nearly at the same time, two other exactly similar masses, and also containing an extension of the central lacuna, are found opposite to one another, on the two remaining sides of the alimentary cavity, so that this cavity is now surrounded by four sacs.

The two last-formed sacs now become divided, each into two, and the divisions thus produced become more and more widely separated from one another, and become superficial to the first formed sacs. We now find them in contact with the peripheral layer of the embryo, where each sac corresponds to the space occupied by a pair of meridional bands and the interval between them.

Lastly, These four sacs begin to divide, each into two, from the peripheral towards the central side, leaving one half adhering by its peripheral side to each meridional band, so that every band has now a sac to itself, and the subsequent conversion of these sacs into the eight meridional canals is easily understood.

About the same time the central lacuna has sent off its two branches, which are to open by external orifices at each side of the ocelliform body; but the author had not succeeded in satisfactorily tracing the formation of these branches.

Hitherto the embryo was confined within the shell, but in the next stage described, the young *Beröe* was free. It was about one-eighth of an inch in length; the meridional bands had extended to somewhat more than half the distance between the ocellus and the mouth. The mouth was surrounded by the circular canal, and the two deep gastro-vascular canals had opened into the latter. The

circular canal probably originates in lateral branches from the distal extremity of the deep gastro-vascular canal ; but the author failed in satisfactorily tracing its mode of development. Four out of the eight superficial gastro-vascular or ctenophoral canals, namely those which corresponded to the narrow sides of the digestive cavity, had also opened into the circular canal ; but the other four meridional canals, though extending for some distance beyond the oral extremities of the meridional bands, had not yet opened into it, and terminated towards the mouth, each in a blind extremity. The eight meridional canals had begun to send out their cæcal offsets ; but these were as yet few in number, and simple. Individuals of about three-fourths of an inch in length had all the gastro-vascular canals in communication with the circular canal. The cæca had become numerous and ramified, and the capillary tubes appeared fully developed. The meridional bands, however, had not yet attained their full extent, their oral termination being still separated from the mouth by a distance equal to about one-third of the entire meridional length of the animal ; while the generative organs had not yet made their appearance, and the processes of the tentacular discs were nearly simple.

3. On the Anatomy and Classification of the Heteropoda. By John Denis Macdonald, Esq., R.N., F.R.S., Surgeon of H.M.S. "Icarus." Communicated by Dr Douglas Mac-lagan.

The author considers the usual division of the Heteropoda into the two families of *Firolidæ*, and *Atlantidæ* as unsatisfactory, and arranges them in three families, according to the following zoological characters.

HETEROPODA.

I. GYMNOSOMATA (*Firolidæ*). Animal wholly naked or without a shell.

1. With slender tentacula, and destitute of true branchiæ. Visceral mass near the root of the filiform process of the Metapodium—*Firoloides*.
2. With rudimentary or no tentacula, but furnished with true branchiæ. Visceral mass considerably in advance of the base of the filiform process of the Metapodium—*Firola*.

II. THECOSOMATA INOPERCULATA (*Carinaridæ*). Animal in great part naked, but having the visceral mass protected by a shell.

1. Shell corneous, with an involute nucleus. Swimming-plate nearly opposite the visceral mass. Metapodium with filiform appendage—*Cardiapoda*.
2. Shell calcareous with spiral nucleus. Swimming-plate considerably in advance of the visceral mass. Metapodium laterally compressed without filiform appendage—*Carinaria*.

III. THECOSOMATA OPERCULATA (*Atlantidæ*.)

1. Shell corneous with an involute nucleus. Operculum subtrigonal, with small lateral subapical nucleus—*Oxygyrus*.
2. Shell calcareous with a spiral nucleus. Operculum oval, with a large median subapical nucleus—*Atlanta*.

After describing the several characters of the order as regards external configuration, eyes, and auditory sacs, the author called attention to the rachidian teeth as being capable of furnishing good generic characters, for which they are especially valuable, as they often outlive the decay of the soft parts.

To avoid undue extension of his paper, the author selected for special description the genera *Firoloides* and *Atlanta*, which occupy, according to his views, the two extremes of the group; and he described in detail, and illustrated by coloured drawings, the anatomy of a species of *Firoloides* which he had met with in Bass's Strait, and the anatomy of *Atlanta*, with reference to all the species of the genus, adding to these some observations on the other genera, and deferring questions of specific determination to a future paper.

4. On the Structure of *Chondracanthus Lophii*; with Observations on its Larval Form. By William Turner, M.B., and H. S. Wilson, M.D., Demonstrators of Anatomy.

The authors, after a brief historical introduction, proceeded to give a detailed account of the anatomy of this parasitic crustacean, the description comprising that of the female and male, and, so far as they had been enabled to trace it, of the larva also.

FEMALE.—Average length, $\frac{1}{2}$ inch; breadth, $\frac{1}{8}$ th inch—divided into cephalic, thoracic, and abdominal portions. Cephalic part presented on each side a lateral process; at the anterior margin a

pair of antennæ; and on the ventral aspect a pair of hook organs and three pairs of foot-jaws. The antennæ were segmented, the terminal segments being provided with hairs. Each hook organ consisted of a basal segment and a terminal hook; the former of which was supported on a well-marked triangular frame, on which it was moved by the action of powerful muscles. The foot jaws, attached a little on one side of the mesial line, consisted of three pairs. The first and second foot-jaws consisted each of two segments. The terminal segment in the first foot-jaw was formed of two chitinic plates, connected by their anterior margins, but separated at their posterior margins, which were armed with teeth. The corresponding segment in the second foot-jaw consisted of but a single plate, toothed along its posterior margin. The third foot-jaw had three segments, the terminal one being destitute of teeth.

The cephalic was separated from the thoracic part by a constricted neck.

The thoracic part was characterised by its processes, seven dorsal, two ventral, and five lateral, the cavities within which communicated with the general cavity of the thorax. Its division into four segments was indicated by constrictions. The first and second segments bore each a pair of feet on their ventral aspects.

The abdominal part, very small, was divided into two segments, the anterior of which presented a pair of nipple-like projections, to one of which the male was attached. Of these the authors gave a minute description. Two genital orifices opened, one on each side of this segment. From each orifice a long string of ova, spirally twisted, depended. The ovaries consisted of a branched system of tubes, occupying the cavity of the thorax, and extending into the processes and feet. Each ovary communicated close to the genital orifice with the cement organ. The alimentary canal, axially situated, commenced at the oral aperture, which was situated immediately in front of the first pair of foot-jaws. It reached almost as far as the thoracic end of the animal. It possessed lateral dilations, but no anus.

MALE, very minute, $\frac{1}{20}$ th of an inch in length, pyriform in shape. Divided into cephalic, thoracic, and abdominal parts—cephalic end broadest and largest; furnished with antennæ, hook organs, and foot-jaws. By its hook organs it was attached to one of the nipple-like projections on the body of the female, on which it was parasitic.

Hook organs and foot-jaws resembling in miniature those of the female. Thoracic part distinctly divided into four segments, the two anterior bearing each a pair of feet. No dorsal, ventral, or lateral processes. Abdominal part divided into two segments, in the proximal of which the two male genital orifices were situated. Alimentary canal in the axis of the animal, with a mouth situated as in the female, but no anus. Testicles bilateral.

Various stages in the development of the ovum, as far as the formation of a free larva, were then described; but the further stages, up to the fully developed animal, the author had no opportunity of tracing.

The following Gentleman was admitted a Fellow of the Society :—

ALEXANDER M'KENZIE EDWARDS, Esq., F.R.C.S.E.

The following Donations to the Library were announced :—

Journal of Agriculture, and Transactions of the Highland and Agricultural Society. No. 75. 8vo.—*From the Highland and Agricultural Society.*

Transactions of the Royal Scottish Society of Arts. Vol. VI. Part 1. 8vo. *From the Society.*

Journal of the Royal Asiatic Society of Great Britain and Ireland. Vol. XIX., Part 2. 8vo.—*From the Society.*

Proceedings of the Royal Horticultural Society of London. Vol. I., No. 1. 8vo.—*From the Society.*

Assurance Magazine. No. XLVI. 8vo.—*From the Society.*

Quarterly Journal of the Chemical Society. No. LVI. 8vo.—*From the Society.*

Journal of the Geological Society of Dublin. Vol. IX., Part 1. 8vo.—*From the Society.*

Report on the Survey of India for 1858–59. Fol.—*From the Survey Directors.*

Rivista da un Cittadino senza partito di cio che si é operato per la Pubblica Istruzione. 8vo. Bologna, 1861.

Monday, 3d February 1862.

DR CHRISTISON, V.P., in the Chair.

The following Communications were read:—

1. Investigation of an Expression for the Mean Temperature of a Stratum of Soil, in terms of the time of year. By J. D. Everett, M.A., Prof. of Mathematics, &c. in King's College, Windsor, Nova Scotia. Communicated by Prof. Tait.

In vol. xxii. of the Transactions of the Society, Prof. W. Thomson has given (after Fourier) the general solution of the problem of underground conduction, and he and Professor Everett have given methods more or less accurate of determining from observation the specific constants for any locality. These are mainly applied to the results of Principal Forbes's observations on the Calton Hill and other places near Edinburgh. (*Trans.*, vol. xvi.)

The present paper has for its object the calculation of the mean temperature of a given stratum of soil at any given time. If v be the temperature at time t , at depth x , v is known by the paper first referred to, in terms of x and t —and the object of the present paper is the easy approximate calculation of the value of the quantity $\frac{\int v dx}{\int dx}$ between any limits of depth x . The method is applied to the Calton Hill observations.

2. Notice of the Catadioptric Altitude and Azimuth Circle.
By Edward Sang, Esq.

This little instrument differs from the ordinary theodolite in the means by which the direction of the object under examination is indicated.

The simplest contrivance for marking the direction of a distant object is a straight rod. This, with the very obvious improvement of studs at the ends, was the only instrument available to the ancients for astronomical observations; it is yet employed in gunnery, and even by surveyors in the plain-table and cross-staff.

The objection to the plain-sight, when it is to be applied to

accurate purposes, is that the eye cannot be adapted to distinct vision for three different distances at the same time. We cannot see the notch, the *visé*, and the object aimed at, all distinctly.

The invention of the telescope effected a complete change in the apparatus for the precise measurement of angles. By it the arrangement of the plain-sight was reversed; the eye-hole was expanded to admit the object-glass, and the image was received at the plane of the cross-wires.

These two are the only improvements which have hitherto been made in the art of pointing. Hadley's quadrant, the invention of which has almost created nautical astronomy, is a contrivance for indicating the difference between the directions of two objects; it does not show the direction of either.

The pointer used in the catadioptric theodolite is thus the third of its class; it contains, literally within the compass of a nut-shell, the means of determining the direction of an object true to within half a minute of a degree.

About the years 1815, 1816, the late Rev. Edward Irving gave to his class of young geometers as an exercise, "To construct graduated squares with plummets attached, by help of which the tangents of angles of elevation may be observed." Some of us used pasteboard, some wood; and it happened that, having broken my school slate, which was a thick one, the idea came into my head to make my square out of the larger fragment. Armed with these little instruments, we attacked and carried most of the surrounding heights. The weather-cock on the top of the church steeple was, as a matter of course, one of our targets. On bringing the upper edge of my slate-square to bear upon it, that upper edge having been ground flat and pretty well smoothed, I saw the inverted image of the weather-cock. It then occurred to me that, if I could bring the image to agree with the weather-cock itself, the plane of the upper edge would be accurately pointed. At the same time it was obvious that when the plane passed through the object there could be no reflection.

Here, then, was a problem "To obtain a reflection such that the reflected can be collated with the direct image, and afford a test of accurate pointing." The pointer used in the catadioptric theodolite exhibits a complete solution of this problem. It is a piece of glass cut in the form of an isosceles tetrahedron, of which two faces form an

edge of about 90° , the other two an edge of about 126° , the one pair being set symmetrically upon the other. This pointer has been patented. On turning it towards any object, and looking into the glass, we perceive an inverted image of the object, and on bringing the eye to look past the edge of the glass, as when using the *camera lucida*, we see the object also; and so can collate the image with the object.

By means of the motions in altitude and azimuth we can cause the image to agree with the object, and are then certain that the line of direction passes through the object.

I do not wish to occupy the time of the Society with a disquisition on the theory of the pointer, but rather to indicate the peculiar facilities which it gives for astronomical and geodetical operations in which a precision to half a minute is sufficient. The instrument is inapplicable whenever greater nicety than this is requisite.

When we point the telescope of a common surveying theodolite to a star, we find that the cross-wires have disappeared in the darkness, and that it is necessary to render the wires visible by making an artificial twilight within the tube. To hold the lamp for this purpose is so troublesome, unless—as in the case of large instruments—a special arrangement be made, that very few surveyors indeed ever use their theodolites for sidereal observations.

But, by using the crystal pointer, the star itself is made the point of reference, and the illuminating apparatus is unneeded.

If we bring the catadioptric theodolite into such a position as to cause the image of a star to agree with the star seen directly, and leave the instrument untouched, the two bright points are seen slowly to separate; while the star moves forward in its diurnal circuit the image moves with the same velocity backwards, the rate of separation is doubled, and the line joining the two points indicates the direction of the motion. In this way it is easy to determine whether the star be ascending or descending, or to judge of its being at its greatest or least altitude. Thus the determination of the latitude from the meridian altitude of a star is very easy; that of the sidereal time is not less so.

We have to note the exact instant at which some star, not far from the prime vertical, has a known altitude. For this purpose we turn the pointer a little in advance of the star, and bring the image to be very nearly above or below the star, according as the observa-

tion is made on the east or on the west side of the meridian. Then, counting the beats of the chronometer, we watch until the line joining the two become horizontal, and thus obtain the instant at which the star had the elevation shown on the altitude circle.

It is better, when making this observation for time alone, to let the image pass at a little distance—say two or three minutes—from the star, than to attempt to make them coincide, because the eye can very readily judge of the horizontality of the line joining the two luminous points. But the altitude azimuth and time can all be obtained at once in the following way :—

Having brought about the coincidence, we watch for one or two minutes, and estimate carefully the direction of the separation, then, by help of the tangent-screws, we cause the image and the star to exchange places, as it were, keeping the same inclination, and leaving the instrument untouched, we count the beats of the chronometer until the coincidence take place. In this way we obtain the time and the simultaneous readings on the altitude and azimuth circles; from these the longitude and the direction of the meridian can be computed.

The direction of the meridian is very readily obtained from the greatest easting or westing of a star which passes between the pole and the zenith, particularly in low latitudes. The manner of proceeding with the crystal pointer is to make the coincidence, to wait a little and observe the direction of separation; when this direction is vertical the star is at its greatest azimuth.

Lastly, the latitude of the place may be corrected by observing the two transits of a star over the prime vertical near to the zenith; the operation is exactly analogous to those already described.

When the horizontal axis is made perpendicular to the meridian the instrument can be used as a transit. The instant of the sun's passage can be found by observing the contact of the first limb, then the entire coincidence, and lastly, the contact of the second limb. The average of these three may, in general, be depended upon to within two seconds of time; while, by observing the moon's meridian passage, and comparing it with those of two stars, the Greenwich time may be obtained to within one minute from a single set of observations.

The lightness and portability of the instrument, and its adaptation to near or distant objects, promise to bring the practice of geode-

tical astronomy within the reach of many who have been hindered from the prosecution of this branch of science by the bulk and expensiveness of the instruments required.

3. On the Nesting Birds of Linlithgowshire and Berwickshire. By the Rev. John Duns, F.R.S.E., Torphichen.

In April 1860, I brought under the notice of the Society a classified list of the Birds of Linlithgowshire. The list was accompanied with notes, "On the Structure and Habits of some of the Rarer Species." After the publication of the Society's Proceedings, several communications were addressed to me by well-known ornithologists, chiefly with the view of ascertaining, if some of the rarer species named had been known to nest in the district. This led to the revision of the list, and to the exclusion of such species as are either rare visitors only, or winter birds of passage. A List of the Birds of Berwickshire, drawn up on the same plan, is now associated with this.

Were similar lists to be drawn up by observers in other counties, the true native birds of Scotland would be better known than they are at present. In most works on British Ornithology they are classed with stragglers from almost every clime.

Several influences are at work, which may soon come to diminish the numbers of our native nesting-birds, and which have already reduced them in certain districts. In the Lowlands, there are now large tracts of country, in which game is not protected, and in which laws of trespass are never enforced. It is thus easy for any youth to carry a gun in quarters in which, a few years ago, he would have been closely watched. The rarer birds suffer; they are intruded on in their favourite haunts, and either scared from them at the breeding season, or wantonly destroyed. The black grouse, which used to breed regularly in Linlithgowshire, is now seldom seen, and the red grouse is now confined to a heath-clad tract, of a few hundred acres, which is being fast broken in upon by mining operations. In the course of four or five years, both species will cease to be reckoned as nesting-birds in the county. The king-fisher, the ring-ousel, the redstart, the gold-crest wren, the bullfinch and goldfinch, have so greatly diminished within a few years, that they are now comparatively rare.

The strict preservation of game has had an influence in another direction. War is waged against every bird believed to be hurtful to the eggs or to the young of the pheasant, partridge, and grouse. The kite has disappeared from the middle and south of Scotland. In Berwickshire, the hen harrier is now rare; and in Linlithgowshire it appears at long intervals as a straggler only. The merlin will soon cease to be met with in both counties. The sparrow-hawk is fast disappearing; and even the kestrel—the farmer's friend against field mice, and several beetles, whose larvæ are most hurtful to his wheat crops—is ignorantly shot down as a plunderer, though entirely innocent touching game. In comparatively recent times, the raven used to nest in Linlithgowshire. It is now never seen. In Berwickshire, it is rare. In Linlithgowshire, the jay is seldom met with, and even the magpie is not able to cope in cunning with the game-keeper.

Agricultural improvements are also beginning to tell unfavourably on some of our native birds. If the alternative were,—“You must either lose the green and corn crops, or destroy the birds,” I suppose even the most enthusiastic naturalist would choose the latter. But it should be the chief aim of the agriculturist to keep the birds alongside of his improvements. Since by drainage, he has banished the wild duck, the curlew, and the snipe, from localities in which they used to abound, he would find it profitable to set apart a spot specially for them. And if he must have stone walls and wire fences, in order to get quit of weeds and to save his crops from insects which find shelter during winter in the hedgerows, he would never regret having left a bush here and there for the birds to build in. If this be not done, he will assuredly find in the turnip-beetles and saw-flies, in the corn-midges and wire-worms—the larvæ of weevils and elaters—“a great people and strong,” enemies, any thousand of which will do more harm to his crops than all the birds of the air would.

In the following list the birds of Linlithgowshire are referred to on the left hand of the column. Those of Berwickshire are characterised on the right hand.

The letter R denotes *Regular*, or birds which breed constantly in the districts; H denotes *Historical*, or birds which used to breed in the localities, but which have for many years ceased to do so; O denotes *Occasional*, or birds which have been known to breed at

long intervals in the districts ; and O, B refers to such as have been seen occasionally at the breeding season, but whose nests have not been discovered.

Linlithgowshire.	Berwickshire.	Linlithgowshire.	Berwickshire.
O. Falco æsalon.	O.	R. Corvus frugilegus.	R.
R. F. tinnunculus.	R.	R. C. monedula.	R.
R. Accipiter nisus.	R.	R. Garrulus melanoleuca.	R.
H. Circus cyaneus.	R.	R. G. glandarius.	R.
R. Strix flammea.	R.	R. Sturnus vulgaris.	R.
R. S. aluco.	R.	R. Pyrgita domestica.	R.
R. S. otus.	R.	R. Fringilla cælebs.	R.
R. Cuculus canorus.	R.	O. F. spinus.	
R. Caprimulgus Europæus.	R.	R. F. carduelis.	R.
R. Hirundo rustica.	R.	R. F. cannabina.	R.
R. H. urbana.	R.	O. F. linaria.	R.
R. H. riparia.	R.	F. flavirostris.	O.
R. Cypselus murarius.	R.	R. Loxia chloris.	R.
O. Alcedo ispida.	R.	R. L. pyrrhula.	R.
R. Certhia familiaris.	R.	O. L. Europæa.	
R. Troglodytes Europæus.	R.	R. Emberiza citrinella.	R.
R. Turdus merula.	R.	O. E. miliaria.	R.
O. T. torquatus.	R.	R. E. shæniculus.	R.
R. T. viscivorus.	R.	R. Alauda arvensis.	R.
R. T. musicus.	R.	R. Anthus pratensis.	R.
R. Cinclus Europæus.	R.	A. obscurus.	R.
O.B. Lanius excubitor.		O. A. arboreus.	O.
L. collurio.	O. B.	R. Columba palumbus.	R.
R. Sylvia rubecula.	R.	C. livia.	R.
R. S. hortensis.	R.	O. Tetrao Scoticus.	R.
S. atricapilla.	O.	O. T. tetrix.	R.
R. S. cinerea.	R.	R. Perdix cinerea.	R.
R. S. phœnicurus.	R.	O. P. coturnix.	
O. S. locustella.		R. Phasianus colchicus.	R.
O. S. arundinacea.	O.	R. Ardea cinerea.	R.
O. Phyllopneuste sylvicola.	R.	H. Botaurus stellaris.	
R. Ph. trochilus.	R.	R. Charadrius hiaticula.	R.
O. Ph. hippolais.	R.	R. Pluvialis aurea.	R.
R. Regulus auricapillus.	R.	P. morinellus.	O. B.
R. Saxicola œnanthe.	R.	Hæmatopus ostralogus.	R.
R. S. rubetra.	R.	O.B. Scolopax rusticola.	
R. S. rubicola.	R.	R. S. gallinago.	R.
R. Accentor modularis.	R.	O.B.S. gallinula.	
R. Parus cæruleus.	R.	R. Numenius arquata.	R.
R. P. major.	R.	R. Totanus hypoleucus.	R.
R. P. longicaudatus.	R.	T. calidris.	R.
R. P. ater.	R.	O. Tringa variabilis.	R.
R. Motacilla Yarrelli.	R.	O. Rallus aquaticus.	R.
R. M. boarula.	R.	R. Crex pratensis.	R.
R. M. flava(Budytes.)	R.	R. Gallinula chloropus.	R.
R. Muscicapa grisola.	R.	R. Fulica atra.	R.
O. M. luctuosa.		R. Cygnus mansuetus.	R.
H. Corvus corax.	O.	R. Anas domesticus.	R.
O. C. corone.	R.	R. A. boschas.	R.
R. C. cornix.	R.	O.B. A. crecca.	O.

Linlithgowshire.	Berwickshire.	Linlithgowshire.	Berwickshire.
O. <i>Anas tadorna.</i>	O.	<i>Larus rissa.</i>	R.
O. <i>Podiceps minor.</i>	R.	L. <i>marinus.</i>	O.
<i>Uria troile.</i>	R.	L. <i>fuscus.</i>	O.
<i>U. grylle.</i>	R.	L. <i>argentatus.</i>	R.
<i>Alca torda.</i>	R.	L. <i>canus.</i>	R.
<i>A. artica.</i>	R.	L. <i>ridibundus.</i>	R.
<i>Pelecanus carbo.</i>	R.	<i>Sterna cantiaca.</i>	R.
P. <i>graculus.</i>	R.	O. S. <i>hirundo.</i>	R.
P. <i>bassanus.</i>	O.	S. <i>artica.</i>	R.
<i>Puffinus anglorum.</i>	O.	S. <i>minuta.</i>	R.
<i>Procellaria pelagica.</i>	O.	S. <i>Dougalii.</i>	O.

A pair of the grey shrikes named in the list, frequented some old thorn trees, near Torphichen village, during the end of May and beginning of June 1846.

The red-backed shrikes were observed by me in July 1859, at Oxendean, near Dunse Castle, Berwickshire. This, I believe, was the first time they have been seen in Scotland. The red-backed shrike passes the winter in Africa, and visits England in May. "It breeds," says Fleming, "in the southern counties of England." "It is," says the late Bishop of Norwich, "generally speaking, very rare in most parts, confining itself to Essex, the Sussex Downs, Wiltshire, and Gloucestershire." Mr Selby has not traced it farther north than Cumberland. M. E. T. Bennet, in one of his notes to White's Selborne, refers to this bird as one which belongs to the south of England, and is scarcely ever met with in the north. In 1840, Mr M'Gillivray recorded that "it had not hitherto been observed in Scotland."

4. Note on Molecular Arrangement in Crystals. By Professor Tait.

To illustrate my lectures on Molecular Forces, I sometimes use piles of marbles of equal size. Each of these is taken to represent the *sphere of action* of a symmetrical integrant molecule, in the sense that the attractive and repulsive forces necessary to a theory of molecules are balanced, when the distance of two molecules is equal to the diameter of the sphere. If the integrant molecules be not symmetrical, their *spheres of action* will be spheroids or ellipsoids.

In arranging such piles, there are two obvious ways of constructing the layers, and two of applying layer to layer.

Thus, a horizontal layer (suppose) may be arranged in *square*, or in *triangular* order; and successive layers may be *simply superposed* or *inserted into interstices* in the preceding ones.

By this it would appear, at first sight, that arrangements of four different densities are producible. Such, however, is not the case. The very obvious results which I intend now to give, must have occurred long ago to others, but I have found no such record; and their apparent novelty to scientific friends to whom I have mentioned them, must be my excuse for occupying the time of the Society with so trifling a matter.

The density of a mass, or the number of marbles per cubic mile (say) is easily seen to be proportional inversely to the product of the distances of the centres of contiguous ones, taken parallel to any three rectangular lines.

Hence

(1.) When layers in square order are superposed, a being the radius of a molecule—

$$\text{Density} \propto \frac{1}{2a \times 2a \times 2a} \propto \frac{1}{8a^3}$$

(2.) Layers in triangular order superposed—

$$\text{Density} \propto \frac{1}{2a \times 2a \times \sqrt{3}a} \propto \frac{1}{4\sqrt{3}a^3}$$

(3.) Layers in square order, interstices occupied by molecules of next layer—

$$\text{Density} \propto \frac{1}{2a \times 2a \times \sqrt{2}a} \propto \frac{1}{4\sqrt{2}a^3}$$

(4.) Layers in triangular order, interstices as before,—

$$\text{Density} \propto \frac{1}{2a \times \sqrt{3}a \times \frac{2\sqrt{2}a}{\sqrt{3}}} \propto \frac{1}{4\sqrt{2}a^3}$$

These densities are (1.) : (2.) : (3.) : (4.) :: $\frac{1}{\sqrt{2}}$: $\sqrt{\frac{2}{3}}$: 1 : 1 ;
or, .707 : .816 : 1 : 1, and may be sought for in various forms of the same body.

Hence, the density in arrangements (3) and (4) is the *same*. It is worthy of note, that the simplest crystalline form which is derivable from (3), is the octahedron of the first system, and that from (4), is its *hemihedral* form, the regular tetrahedron.

By inspecting the piles of marbles for the two cases, it is easy to see without analysis, that the densities are equal. This is best seen by removing an *edge* of the tetrahedral pile.

I have tried to connect these results with allotropic forms of bodies which crystallize in the first system (and an easy modification allows us to pass to other systems)—but though diamond and graphite *seem* to agree so far with it—it must be taken at present as a pure speculation.

The following Gentlemen were admitted Fellows of the Society :—

WALTER BOYD M'KINLAY, M.D., F.R.C.S.E.

EDMUND RONALDS, Ph.D.

JOHN J. MACARTNEY, M.D.

The following Donations were received :—

Quarterly Report of the Meteorological Society of Scotland. 8vo.

—*From the Society.*

Twelfth, Thirteenth, and Fourteenth Annual Reports of the Regents of the University of the State of New York, on the Condition of the State Cabinet of Natural History. 8vo.—*From the New York State Library.*

Seventy-Third and Seventy-Fourth Annual Reports of the University of the State of New York. 8vo.—*From the same.*

Forty-Second and Forty-Third Annual Reports of the Trustees of the New York State Library. 8vo.—*From the same.*

Guide to the Geology of New York, and to the State Geological Cabinet. 8vo.—*From the same.*

Magnetical and Meteorological Observations made at the Government Observatory, Bombay. 1859. 4to.—*From the India Office.*

Vis Inertiæ Victa, or Fallacies affecting Science. By James Reddie. 1862. 8vo.—*From the Author.*

Contribuciones de Colombia. Por E. Uricocchea. 1860. 8vo.—*From the Author.*

Memoire sur l'Integration des Equations Differentielles relatives au Mouvement des Cometes. Par Jean Plana. 1861. 8vo.—*From the Author.*

Proceedings of the Royal Geographical Society of London. Vol. VI.,
No. 1. 8vo.—*From the Society.*

Astronomical and Meteorological Observations made at the Radcliffe
Observatory, Oxford, in the year 1858. Vol. XIX. 8vo.—
From the Observatory.